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ABSTRACT

This study is an attempt to investigate the usefulness of imagery instructions in learning PA nouns embedded in sentences and conjunction phrases with three different age groups (third grade, sixth grade and college students). In addition, six different item types are employed to convey increasingly dissimilar contexts from study to test trials. It was predicted that imagery instructions would show a decreasing facilitatory effect as a function of age. Results show that imagery instructions facilitated recall significantly for sixth graders, but no instructional effect was found for third graders, and a small, but not statistically significant effect occured at the college level. It is concluded that imagery is a useful mediator for sixth graders and above, while third graders are too developmentally immature to utilize self generated imagery. Semantic factors in learning are important, but imagery instructions used effectively may facilitate learning regardless of the semantic context involved. (Author/FC)

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Technical Report No. 159

THE USE OF IMAGERY INSTRUCTIONS IN CHILDREN'S LEARNING AS A FUNCTION OF AGE

Report from the Project on Verbal and Visual Processes in Children's Learning element of the Project on Variables and Processes in Cognitive Learning

by

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STATEMENT OF FOCUS

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Project on Variables and Processes in Cognitive Learning in Program 1, Conditions and Processes of Learning. General objectives of the Program are to generate knowledge about concept learning and cognitive skills, to synthesize existing knowledge and develop general taxonomies, models, or theories of cognitive learning, and to utilize the knowledge in the development of curriculum materials and procedures. Contributing to these Program objectives, this project has these objectives: to ascertain the important variables in cognitive learning and to apply relevant knowledge to the development of instructional materials and to the programming of instruction for individual students; to clarify the basic processes and abilities involved in concept learning; and to develop a system of individually guided motivation for use in the elementary school.

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J. M. H.

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ABSTRACT

A recent revival in research concerning the use of visual imagery as a mediator in paired-associate learning has indicated its facility with adults and older children (above fifth grade). The present study was an attempt to investigate concurrently the usefulness of imagery instructions in learning PA nouns embedded in sentences and conjunction phrases with three different age groups (third grade, sixth grade, and college students). In addition, six different item types were employed in order to convey increasingly dissimilar contexts from study to test trials. This part of the study was a replication of a previous study (Levin and Horvitz, in press). It was predicted that imagery instructions would show a decreasing facilitatory effect as a function of age, i.e., it would be most useful for third graders and least useful for college students (since the latter would presumably use such strategies independently). It was also predicted that imagery would facilitate recall on semantically similar study-test item types, and inhibit recall on semantically dissimilar study-test item types.

Imagery instructions were found to facilitate recall singificantly for sixth graders, but no instructional effect was found for third graders, and a small, but not statistically significant, effect occurred at the college level. Item type profiles for all three grades replicated the previous study, but the predicted interaction of instructions with item types did not occur. Thus, imagery instructions were generally beneficial for all semantic contexts at the sixth grade and college level.

It was concluded that imagery is a useful mediator for sixth graders and above, while third graders are too developmentally immature to utilize self-generated imagery; semantic factors in learning are important, as demonstrated by the replication of the previous study, but imagery instructions used effectively may facilitate learning regardless of the semantic context involved.

A developmental trend was evident with respect to the kinds and amount of experiment-provided cues necessary for imaginal production and mediation.

Chapter I

INTRODUCTION

"Elaboration", as introduced by Rohwer (1967), refers to subject-initiated events related to learning, in excess of the nominal stimuli and responses, and which may include imaginal processes. In paired-associate (PA) learning, for example, one form of elaboration might consist of a sentence relating the stimulus and response terms, as in "The COW chases the BALL" (where "cow" and "ball" are the to-be-associated words). Such a process is sometimes referred to as verbal elaboration. Another type may be called visual (or pictorial) elaboration, a process whereby a visual image of an interactive scene involving the objects to be recalled is formed in the subject's mind. In other research such phenomena have been discussed under the topic of "mediation", and for present purposes the terms "elaboration" and "mediation" will be interchangeable, with visual imagery representing a particular subset. It should also be noted that in this paper the term "imagery" will be restricted to visual imagery, despite other researchers having discussed such things as verbal imagery, tactile imagery, olfactory imagery, etc. (See, for example, Richardson, 1969.)

Review of the Literature

The role of visual imagery in learning, largely ignored throughout the history of modern psychology, has received a great deal of atten-

tion in recent years. Richardson (1969) has devoted considerable space to the topic; an imagery symposium recently filled a large portion of the Psychological Bulletin (1970); and Bugelski (1970) has brought the subject into focus in the American Psychologist. Thus, it cannot be denied that the study of imagery has had a rebirth. Much of the research responsible for the rebirth has emanated from the laboratories of Allan Paivio and his students.

Before the revival of imagery research, mediation research in PA learning had traditionally focused on word meaningfulness (m), which was thought to be an important variable facilitating learning. However, Paivio and his associates have classified words in terms of their imagery-evoking capacity. He regards images as "symbolic processes which are linked developmentally to associative experience involving concrete objects and events", and "in relation to language, as conditional sensations for which appropriate words function as conditioned stimuli" (Paivio, 1969). Thus, the greater the concreteness of stimulus items, the more likely they would be presumed to evoke sensory images that can function as mediators in associative learning (even when m is held constant). In a series of studies (e.g., Paivio & Yuille, 1967; Smythe & Paivio, 1968; Paivio, Smythe, & Yuille, 1968) where imagery (I) and m were each varied independently with the other held constant on two PA lists, and where I and m were covaried on another list, Paivio concluded that I accounts for more of the variance in PA learning than m does, and that I is a more potent variable with respect to PA learning than is m. Furthermore, in a subsequent factor-analytic

study, Paivio (1968) found that of all factors, I correlated most highly with learning.

Paivio (1965) had previously tested what he has called the "conceptual peg hypothesis": that both stimulus and response words in a PA task evoke images which in turn produce a compound image. These images are formed during the subject's study trials, and on the test trials the stimulus word evokes the compound image, from which the response word is retrieved. Using four types of PA lists, concrete (stimulus nouns) - concrete (response nouns), concrete-abstract, abstract-concrete, and abstract-abstract, Paivio found learning to be most efficient (i.e., from best to worst) in that order. What is particularly significant here is that concrete-abstract lists were more easily learned than were the abstract-concrete. Thus, stimulus concreteness is important since it presumably evokes the image from which the response word is retrieved, even when the latter is abstract. However, when the stimulus word is abstract, the compound image or conceptual peg is not easily rendered, resulting in poorer response noun retrieval.

Paivio and others have continually found support for the hypothesis that imagery serves as an effective mediator in associative learning. Berlyne (1965) hypothesized that chains of associative transformations involving either words, images, or both can occur and serve mediational functions in verbal learning. It might, in fact, be predicted that an interaction between mediator type (visual vs. verbal) and word concreteness exists, whereby concrete nouns would be more likely to evoke

pictorial imagery, while verbal mediators would occur relatively independently of noun concreteness. In support of the above contention, Paivio (1966) analyzing Ss' self reports found that Ss used imagery mediators when stimulus and response words were both concrete, while verbal mediators were used when both stimulus and response words were abstract. Moreover, the pairs for which imaginal mediation was used were found to be learned better. A more recent study (Paivio & Foth, 1970) found imagery mediation to produce higher recall than verbal mediation with concrete noun pairs, while with abstract pairs the reverse was true.

Further evidence of facilitation in learning concrete (relative to abstract) words in PA tasks has been found in another Paivio and Yuille study (1969) and by Taylor and Black (1969).

Just as concrete word pairs have been found easier to learn than abstract pairs, so too might actual objects (or pictures of objects) be expected to be more easily recalled than concrete word pairs on the basis of the same "imagery" argument. Thus, Rohwer (1967), using third and sixth graders, found a pictorial representation of PA materials (where pictures of concrete nouns were presented) to be superior to a verbal representation (where the usual method of presenting just the nouns was used). Other studies have supported the idea that college Ss employ verbal elaboration in PA learning without being so instructed (e.g., Runquist & Farley, 1964). However, these data came from subjects' self reports, which are often unreliable and, in most cases, after the fact. Jensen & Rohwer (1965) found that verbal elaboration instructions

generally facilitated PA learning for elementary school children, but for older ones (junior high and above). This finding lends support to the contention that older Ss use self-initiated elaboration (i.e., they are elaborating on their own).

Since research has pointed out the relevance of imagery mediation in learning, the next logical question is whether imagery instructional sets, where subjects are instructed or given the suggestion to formulate a picture in his mind of an interactive scene involving the stimulus and response words, will also facilitate learning. Then, if facilitation is derived from such instructions relative to non-instructed groups, are there certain conditions under which facilitation will and will not be produced? For example, one might ask what effect imagery sets will have for different age groups, or for different kinds of learning materials (i.e., prose learning, poetry, etc.) The answers to these and similar questions could have vast implications for our educational systems, since if imaginal mediation is in fact a catalyst in certain types of learning situations, it behooves us to delineate exactly what conditions do call for such mediation so that the training of these methods may be implemented with school-age children.

Several studies have been done to examine the effect of imagery instructional sets on learning. Bower (1969) used PA tasks with college Ss and tested them on immediate and delayed recall. Imagery instructions were found to be effective for both. Using a keyhook procedure in a free recall task, where several response words were hooked on (imaginally) to a single stimulus word in the study trials, Bower

found that imagery elaboration enabled Ss to hook up several response words to the same stimulus. Taylor and Black (1969) studied the effect of imagery instructions among sixth grade children. They found the instructional effects to be significant. In addition, about half of the non-mediation instruction Ss reported using imagery on their own. Interestingly, it was found that these Ss learned better than their non-mediation colleagues who did not report using imagery; and their performance was only slightly lower than the imagery-instructed Ss. This study strongly suggests that self-initiated visual elaboration begins even in the late primary grades, with more and more Ss at older ages spontaneously employing imagery as a learning strategy.

Paivio & Yuille (1969), in a study with adult Ss, using both verbal and imagery instructional sets, found that both procedures facilitated learning relative to a no set condition and a PA repetition condition. However, the effects disappeared by the third trial, and this was attributed to the fact that the control Ss probably started using elaboration on their own. (The occurrence of a ceiling effect might be another explanation.)

Wallace, Turner, and Perkins (1957), using imagery instructions with adult Ss, but no control group, found that subjects could store an amazing amount of information (about 700 items) with very few trials. To date, the only known attempt at using imagery instructional sets with children younger than sixth graders was by Spiker (1960) who discovered that youngsters as low as fifth grade could use an imagery mnemonic device to increase recall.

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Chapter II

STATEMENT OF THE PROBLEM

The research reviewed has shown imagery-concreteness to be an effective and potent variable in PA learning. It appears that imagery is a preferred type of mediator in word pairs where at least the stimulus word is concrete and possesses High I (Paivio, 1969), and that verbal mediation is less affected by concreteness (Paivio & Foth, 1970). The research also indicates that imagery instructional sets are beneficial for all age groups studied thus far (i.e., fifth graders through adults). Yet, if older groups initiate their own imaginal mediation (at least when the stimulus word is concrete), as has been intimated by some studies, then if might be asked to what degree such instructional sets will benefit different age groups. A comparative study of this type has not yet been done.

One purpose of the present study, then, is to compare performances on PA tasks of third grade, sixth grade, and college students given or not given imagery instructions. It is hypothesized that third grade students do not use self-initiated imaginal elaboration, that college students do, and that sixth grade Ss probably fall in the middle. On this basis one might expect to find a decreasing difference between performance with the two types of instructions as a function of age. That is, instructional effects should be most profound for third

graders, less for sixth graders, and even less for college students.

Another purpose of the present study is to replicate and extend the findings of a previous study by Levin and Horvitz (in press), which included an investigation of the role of semantic factors in learning. In that study, sixth grade children were given a 12-item mixed list of PA's with six different types of items included in the list.

Item Types I-IV all consisted of pairs within the same sentence frame on the test trials, but the sentences presented on the study trials differed throughout the four item types as follows:

Item Type I consisted of pairs within the context of a meaningful sentence. On the test trial, the subject received the same sentence frame without the response word. An example:

Study: A friend mixes the deck.

Test: A friend mixes the ____.

Item Type II consisted of pairs in a sentence again, but the connective verb of the sentence on the test trial was a synonym of that presented on the study trial.

Study: A friend shuffles the deck.

Test: A friend mixes the ____.

Item Type III consisted of pairs where the test trial sentence frame contained a verb of different implied activity, i.e., one that signalled a different interactive episode between stimulus and response noun, than that of the sentence frame in the study trial.

Study: A friend deals the deck.

Test: A friend mixes the ____.

Item Type IV consisted of pairs within a sentence where the verb was changed on the test trial in such a way as to introduce a difference in meaning of the response word. An example of this is given by:

Study: A friend paces the deck.

Test: A friend mixes the ____.

In addition, two control item types were included.

Item Type V consisted of pairs within the context of a sentence on the study trial, while a conjunctive phrase frame was presented on the test trials.

Study: A friend mixes the deck.

Test: A friend and the ____.

Finally, Item Type VI consisted of pairs within the context of a conjunction phrase on both study and test trial.

Study: A friend and the deck.

Test: A friend and the ____.

Each subject received two different sentences for each item type, and through randomization across Ss, each word pair was used in every item type.

Levin and Horvitz hypothesized that if semantic factors are involved in the learning of such PA items, a decrement in performance would be predicted as a function of semantic dissimilarity (between study and test contexts). "In terms of recall, the first four item types would be rank-ordered: I, II, III, IV (best to worst) where study and test contexts are identical at one end (I), while at the other end (IV) dissimilar sentence meanings are conveyed."

The above prediction was in fact confirmed. Recall on Item Types I-IV was progressively decremental. In fact the relationship was perfectly linear with equal differences between I and II, II and III, and III and IV. However, performance on Item Type V unexplicably dropped (though not significantly) below IV, and Item Type VI was better than either IV or V. The unexpected difference between Item Type V and Item Type VI was intriguing in that it was counter to the "verbal elaboration effect" which has already been discussed. Explanation of this result have been considered elsewhere, however (Levin, Horvitz, & Kaplan, in press).

A secondary hypothesis that could be formulated in the Levin and Horvitz study was that if sixth graders did use imagery mediation spontaneously in learning the sentence-embedded pairs, then interference should occur when the relationship between stimulus and response nouns is changed (via the manipulation of the verb) on test trials. For instance, a mental picture of a person pacing the deck of a ship should facilitate learning of the PA words "friend-deck" when presented as "A friend paces the deck." But when the test sentence frame is changed so as to yield a different meaning of the response noun--one that does not fit the originally elicited image (The friend mixes the ____)--then recall should be disturbed since the response noun should be more difficult to retrieve. In the Levin and Horvitz study, this is what occurred (Item Type IV was worse than Item Type I), and therefore the possibility that Ss were using imagery mediation is not easily dismissed. The present study includes an attempt to partially deal with

this question, since the performance of Ss explicity instructed to use imagery (and presumably doing so) will be examined as explained below.

The possible questions to be answered by the present study may then be listed as follows:

1. Will there be a difference in total performance of imagery-instructed and nonimagery-instructed subjects? The previous research (generally with college Ss) which suggests that imagery instructions do facilitate learning would lead us to hypothesize a main effect here. However, will this effect change as a function of age? The hypothesis that older Ss use self-initiated imagery while younger Ss do not would have us expect differential effects, with instructions providing more of a benefit for third graders, less for sixth graders, and even less for college Ss. If this effect were not revealed by the data, i.e., that third graders show no more instructional effect than college Ss, one of two rival hypotheses seems plausible at the present time: (a) third graders are no different than college Ss in their use of self-initiated imagery, or (b) third graders may simply be too developmentally immature to effectively use imagery instructions (e.g., Hunt, 1961; Bruner, 1960; Kendler & Kendler, 1962; Jensen & Rohwer, 1965).

2. Will there be differences among item types similar to those obtained by Levin and Horvitz? In other words, will the profile of performances on the six item types in the previous study (for sixth graders) also reveal itself in this study, but across age groups? Then, will the profiles for the different age groups be similar?

This part of the study is a replication of the Levin and Horvitz study. Although these authors interpreted their results in terms of the semantic changes as a result of verb manipulation, an alternative explanation may be offered via the imagery route. If the profile for Item Types I-IV obtained by imagery-instructed Ss is consistent with that found by Levin and Horvitz, then more support can be given to the hypothesis that interference is occurring as a result of imagery usage when the manipulation of the verb changes the interactive scene depicted by the sentence. (Either that or the argument that imagery is not involved in learning, which has presumably been disproved.)

3. Will instructions improve performance on some kinds of items relative to others? The hypothesis is that instructions will be facilitative for Item Types I and II, while it would be less predictably so for Item Type III and likely to be interfering for Item Type IV. The reasoning here is that Item Type I and II contain the same interactive episode on study and test trials, and since instructions should promote the imagery of such scenes, performance should be better for those Ss using imagery than those not doing so. However, since in Item Types III and IV a change in the implied activity or in the meaning of the test trials is made, then imagery usage should be non-facilitative, or even interfering for those item types. Therefore, one would expect those Ss not encouraged to use imagery to perform as well or even better than imagery-instructed subjects on such items. Since Item Types V and VI (verb-conjunction and conjunction-conjunction) are neutral (on the test trial) with respect to the activity taking place, then per-

formance here may also be facilitated by imagery instructions. Imagery usage should not impede performance on these item types, but should help the subject's recall.

A final question may be asked. Will the instructional effects on item types change as a function of age? That is, will the differences, if found, for different item types as a result of instructional effects be the same for all three age groups? According to the previously stated hypothesis that older Ss use self-initiated imagery and younger Ss do not, then the debilitating effects for Item Types III and IV should not be as great for imagery-instructed college Ss than for younger Ss who are given imagery instructions. At the same time, the facilitating effects of imagery for Item Types I, II, V, and VI should also be less for the college population.

Chapter III

METHOD

Subjects

Sixty third-grade students, sixty sixth graders, and sixty college students (undergraduates and graduates) participated in the study. The elementary school Ss were drawn from a school district serving a semi-rural community in the Midwest. The third graders were in a building housing grades 1-5 while the sixth graders were in an adjacent building housing grades 6 and 7. The college students were all volunteers attending the University of Wisconsin at Madison and were largely, although not completely, comprised of education majors.

Half of the Ss from each grade level were given imagery instructional sets while the other half were given standard PA instructions. Ss were assigned randomly to these groups and the order to testing was also random.

Design and Materials

The design for each grade level consisted of a single between-subjects factor (Instructions) and two within-subject factors (Item Types and Trials). Grade levels were analyzed separately because it was expected that the variability of scores in the three age groups would be quite different. The design is presented in Table 1.

Table 1

			REPEATED MEASURES	
			TRIAL I	TRIAL II
GRADE 3	Imagery	30 Ss	Item Types I - VI	Item Types I - VI
	No Imagery	30 Ss	Item Types I - VI	Item Types I - VI

			TRIAL I	TRIAL II
GRADE 6	Imagery	30 Ss	Item Types I - VI	Item Types I - VI
	No Imagery	30 Ss	Item Types I - VI	Item Types I - VI

			TRIAL I	TRIAL II
COLLEGE	Imagery	30 Ss	Item Types I - VI	Item Types I - VI
	No Imagery	30 Ss	Item Types I - VI	Item Types I - VI

The sentence and conjunction phrase materials were typed onto white onion skin paper, photographed, and mounted onto slide transparencies. They were presented via a Carousel slide projector and viewed by S on a small screen placed in front of him.

Twelve pairs of concrete nouns were embedded into six different item type forms (following Levin & Horvitz, in press). These different item types were varied by manipulation of the connective from study to test trials. Item Type I consisted of a sentence with the same verb on study and test trials; Item Type II consisted of a sentence containing a synonymous verb on the test trials; Item Type III consisted of a sentence with a verb implying a different activity (than that on the study trials) of stimulus and response nouns on test trials; Item Type IV consisted of a verb change such that a different meaning of the response noun was implied on the test trials; Item Type V was characterized by a sentence on study trials, a conjunction frame on test trials; and Item Type VI consisted of conjunctive phrases on both study and test trials. Each sentence or phrase was in the form of article-noun-verb (or conjunction)-article-noun. See Appendix A for a list of the noun pairs used and the connectives used for the item types associated with each pair.

Six different order combinations were used so that every noun pair could be incorporated into each item type. In each arrangement, then, two noun pairs were associated with each item type. The different combinations were randomly assigned to Ss such that each arrangement was used an equal number of times.

All noun pairs were concrete although they were not selected in accordance with Paivio's (1968) imagery ratings. Rather, it was necessary to select nouns that could fit into meaningful sentences as defined by the item types used, and response nouns had to contain more than one meaning in order to employ Item Type IV.

The verbs utilized to manipulate the semantic changes were selected after pre-testing a group of 10 fourth graders to gain consensus on the type of image they formulated given the prescribed sentences.

Procedure

All Ss were tested individually. Upon entering the experimental room S was seated a few feet in front of a small screen upon which the verbal materials could be clearly presented. The instructions were then read by E.

Ss in the regular-instruction condition were told that they would be seeing some sentences and phrases, with two capitalized words (the PA words) in each one, and that the second such word would be underlined. They were told to try to remember the capitalized words that went together in each sentence or phrase because later, after being shown part of each sentence or phrase without the second capitalized word, they were to supply E with the missing word. They were cautioned that the part of each sentence or phrase they were to see later might be a little different from what they saw initially, but the first capitalized word would always be present.[1]

Three sample items were given to familiarize S with the ensuing task as well as to clarify for him the possible changes that might

take place between study and test trials. In two of the examples the connective was changed (verb to conjunction, and verb to preposition) from study to test trials, and in one example a conjunction appeared on both study and test trials. Upon ascertaining that, for certain, S understood the instructions, the regular task was begun.

Ss in the imagery-instruction condition were given identical instructions regarding the capitalized words to be learned in the sentences and phrases, and regarding the switches that might take place from study to test trials. But, in addition, they were told that a good way to remember the words was to "make up a picture" (third and sixth grades) or to "formulate a mental image" (college Ss) of what was happening in each sentence or phrase, and that when they were later shown part of each sentence or phrase, thinking back to the picture they had before would help them remember the missing word.

The same three examples used for regular-instructed Ss were presented for the imagery-instructed Ss. For each one, upon presentation of the study material, Ss were told to form a mental picture of the implied action or possible action taking place. They were then shown a picture of one of the possible action scenes and told that this picture was "one possible thing" they might have thought of. E then presented the sentence or phrase stem and told S that thinking back to the "picture" or "image" would help him remember the missing word, which he was then asked to supply.

E presented the twelve study items to S one at a time at a 5-second rate while they were concurrently read aloud on a tape recorder. Fol-

lowing the last item there was a 10-second interval in which nonimagery-instructed Ss were reminded that they would see and hear part of each sentence or phrase and that they were to tell E the missing underlined word. Imagery Ss were reminded of the same instructions with the reminder to think back to their "pictures" or "images" to help remember the words. The test frames were then presented at a 5-second rate while being read aloud on the tape recorder. S supplied the missing response nouns vocally. After exposure of the last test item, all Ss were reminded of their previous instructions before proceeding through another study-test cycle. On each of the two study and test trials the twelve items appeared in a different random serial order so as to remove position cues as possible sources of variance.

Chapter IV

RESULTS

Learning was measured in terms of the number of correct responses given on each of the two test trials. All hypotheses in the study were tested with the probability of Type I error (α) set equal to .05. Since the data were analyzed separately for each grade level (third grade, sixth grade, and college) the results will be presented here separately for each grade level. The differences in the instructional effect at each age level will later be compared descriptively.

A multivariate analysis of variance (for repeated measurements) was performed. The twelve dependent measures were initially transformed into eleven new variables in order that hypotheses regarding item type differences, trials differences, and their interaction might be tested. In addition, the sum of the original twelve dependent measures provided for between-subjects (instructions) differences in overall performance (Morrison, 1967).

Third Grade

Looking at the between-subjects tests first, no significant effects can be traced to instructions ($F < 1$ with 1 and 58 df). Thus, the instructional effect predicted here did not occur, as seen in Figure 1.

Within Ss, and as in most PA learning studies, a significant effect of trials was found ($F = 190.50$ with 1 and 58 df). Neither Instructions

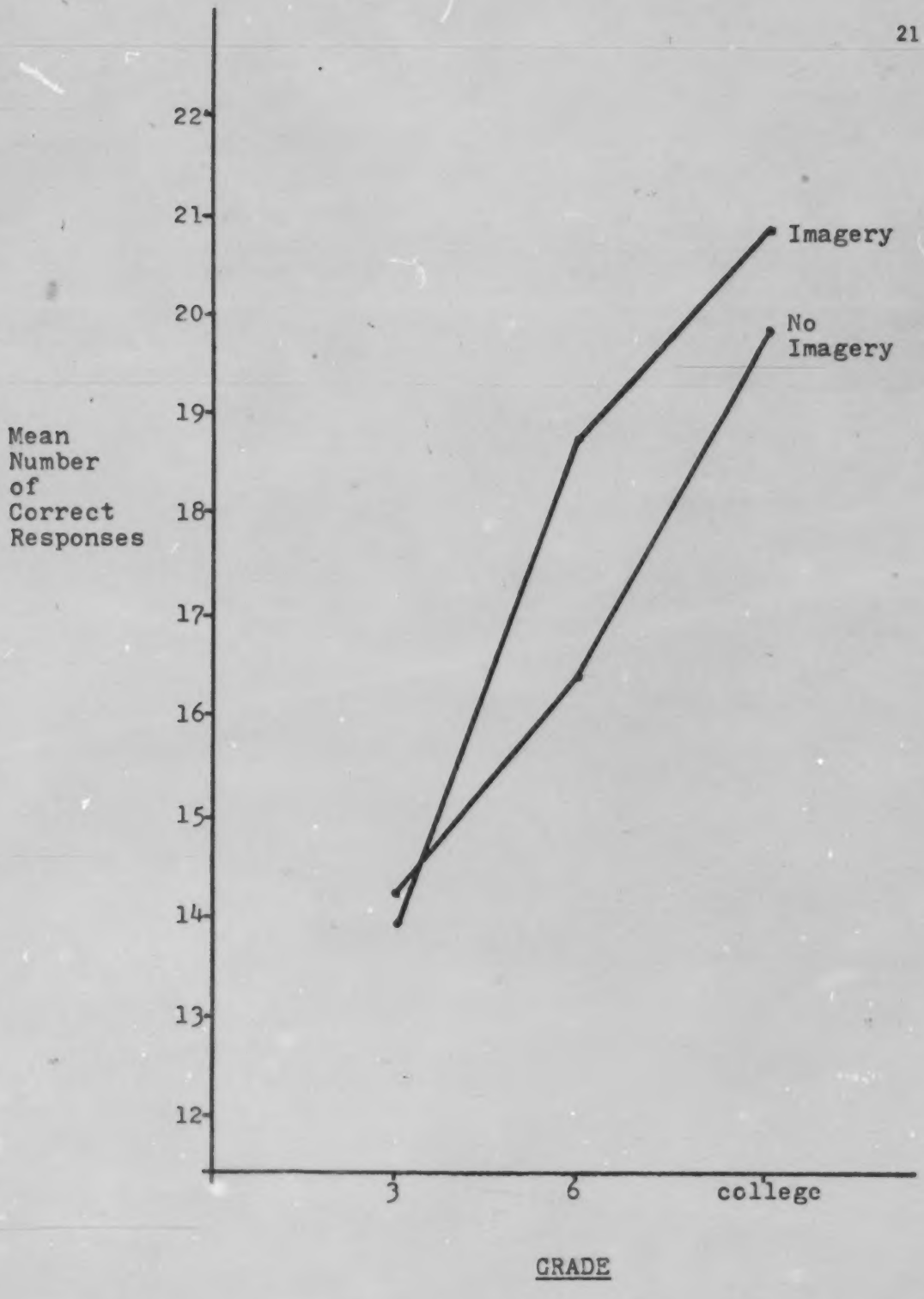

Figure 1

Mean Number of Correct Responses for each Grade Level as a Function of Instructions and summed over Trials

by Trials nor Item Types by Trials interaction was significant ($F < 1$ with 1 and 58 df and $F < 1$ with 5 and 54 df, respectively). Thus, improvement was substantial on the second trial for all item types and for both imagery and normally instructed groups.

The multivariate test for item type differences revealed a statistically significant effect ($F = 12.59$ with 5 and 54 df). The pattern of item type differences across trials for each of the instructional groups may be seen in Table 2. The item type profile seen in Figure 2 corresponds fairly closely to that obtained for sixth graders in the Levin and Horvitz (in press) study and to what was predicted for all three groups in this study. Item Types I, II, and III did not appear to be different from one another. However, a sharp decrease in recall occurred between Item Types III and IV, and a very small drop was noticed between Item Types IV and V. Item Type VI, however, was higher than IV but lower than III.

To account for the specific item type effects taking place, post-hoc multivariate comparisons were undertaken as described by Morrison (1967). Through pair-wise comparisons it was found that no significant differences existed among Item Types I, II, and III. These were the three item types where semantic changes were very slight, if at all. However, all three of these item types were significantly different from Item Type IV (where a complete meaning change took place between study and test contexts). In addition, Item Types I, II, and III were found to be different from Item Type V (sentence-conjunction); and Item Type I (but not II and III) was different from Item Type VI (conjunc-

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Table 2

Mean Number of Correct Responses for each Item Type and each Trial: Third Grade

Trial 1:

	Item Type I	II	III	IV	V	VI	
No Imagery	1.27	.90	1.00	.70	.67	.83	5.37
Imagery	1.10	1.20	1.13	.77	.53	.67	5.40

Trial 2:

	Item Type I	II	III	IV	V	VI	
No Imagery	1.87	1.67	1.57	1.20	1.13	1.40	8.84
Imagery	1.63	1.53	1.67	1.10	1.17	1.43	8.53

Both Trials:

	Item Type I	II	III	IV	V	VI	
No Imagery	3.13	2.57	2.57	1.90	1.80	2.23	14.20
Imagery	2.73	2.73	2.80	1.87	1.70	2.10	13.93

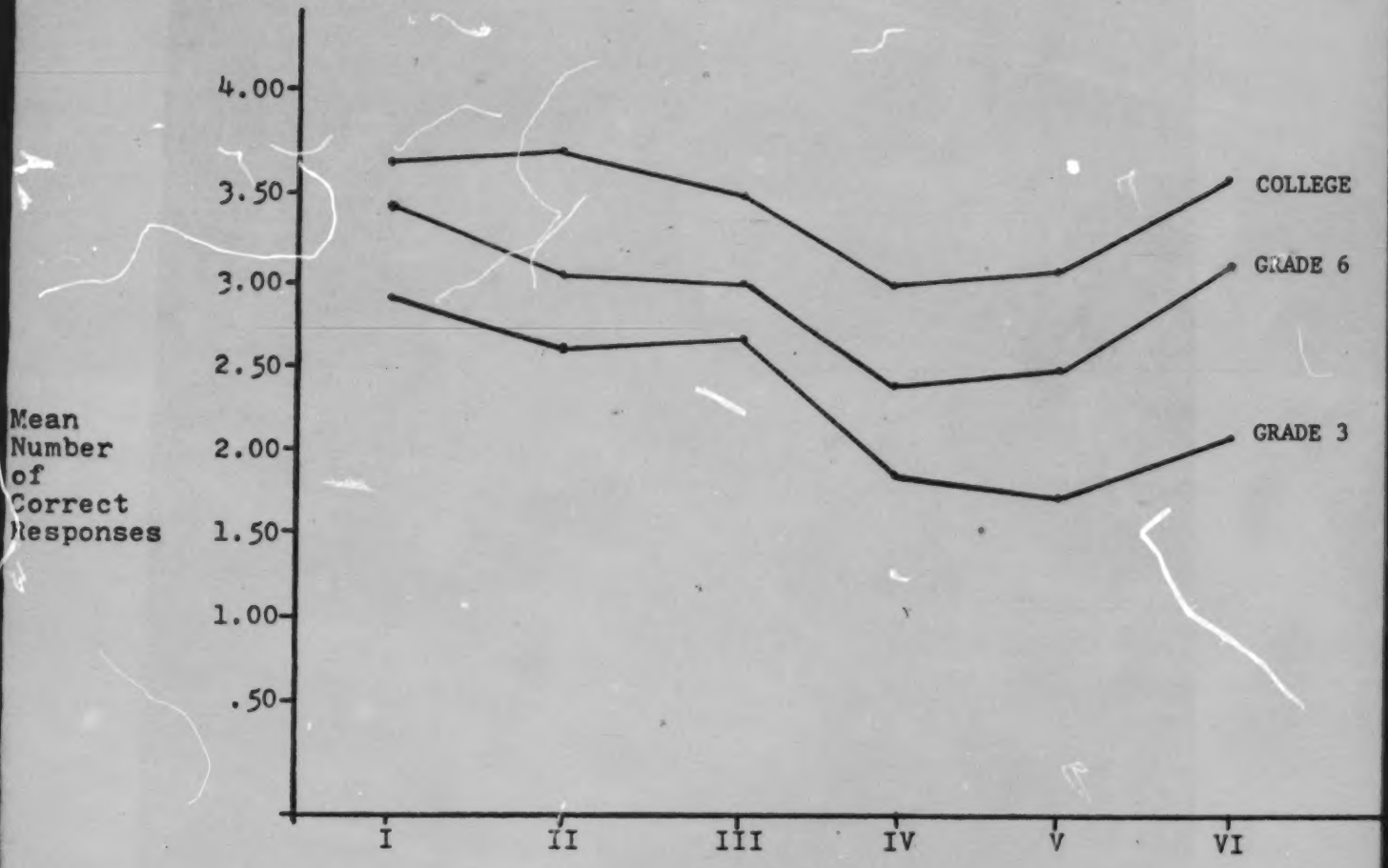


Figure 2

Mean Number of Correct Responses at each Grade Level for each Item Type summed over Trials and averaged over Instructions

tion-conjunction).

It was found that the differences among the first four item types could be simply described in terms of a straight line, since a post hoc linear contrast (but not a quadratic of cubic) was statistically significant.

The Instructions by Item Type interaction was not significant (F = 1.06 with 5 and 54 df). Thus, the smaller instructional effect predicted for Item Type IV relative to the other item types did not occur. Rather, it may be assumed that the differences in recall incurred among the various item types were statistically parallel for both instructional groups.

Sixth Grade

In the sixth grade sample the one between-subjects comparison, the effect of instructions, did attain significance (F = 7.46 with 1 and 58 df). This result is much in accordance with the prediction that imagery instructions would facilitate learning for sixth graders, and, as will be seen, the facilitation manifested for this age group, was more striking than that obtained for the college students.

Looking at the within-subjects tests, significant effects were revealed for Item Types (F = 10.00 with 5 and 54 df) and Trials (F = 274.82 with 1 and 58 df), just as they were in the third grade data. In addition, an Instruction by Trials interaction was significant (F = 16.99 with 1 and 58 df). This effect did not occur for the third graders.

The Item Types and Trials main effects were consistent with what was predicted. The pattern of item type differences in response noun recall may be seen in Table 3 and Figure 2. As was the case for the third graders, the first three item types did not appear to be significantly different from one another. It should be remembered that the materials presented for these items were similar on study and test trials. However, a marked decrease in response noun recall did seem to manifest itself on Item Type IV where a sharp semantic switch occurred between study and test trials as a result of the verb manipulation. Item Type V was only slightly higher than Item Type IV, and Item Type VI was almost as high as Item Type III. As may be seen in Figure 2, the sixth grade item type profile was virtually parallel to the third grade profile.

Post hoc comparisons were undertaken in order to detect specific differences among item types. Results indicated that Item Type I was significantly different from IV and V, and that Item Type II was significantly different from V. The linear trend among Item Types I-IV was again significant while no cubic or quadratic components were found. Thus, differences among those item types may be assumed to be assimilating a decreasing straight line.

Figure 3b reveals some interesting findings. There it may be seen that the difference manifested by instructions was erased on Item Type VI. Also, the instructional difference for Item Type IV seems to be smaller than that revealed for other item types (excluding VI), and this result might be supportive of the prediction that imagery instructions

Table 3

Mean Number of Correct Responses for each Item Type and each Trial: Sixth Grade

Trial 1:

	Item Type I	II	III	IV	V	VI	
No Imagery	1.33	1.17	1.07	.73	.67	1.30	6.27
Imagery	1.77	1.53	1.57	1.00	1.17	1.23	8.27

Trial 2:

	Item Type I	II	III	IV	V	VI	
No Imagery	1.90	1.73	1.73	1.50	1.43	1.73	10.02
Imagery	1.87	1.83	1.77	1.60	1.70	1.77	10.54

Both Trials:

	Item Type I	II	III	IV	V	VI	
No Imagery	3.23	2.90	2.80	2.23	2.10	3.03	16.29
Imagery	3.63	3.37	3.33	2.60	2.87	3.00	18.80

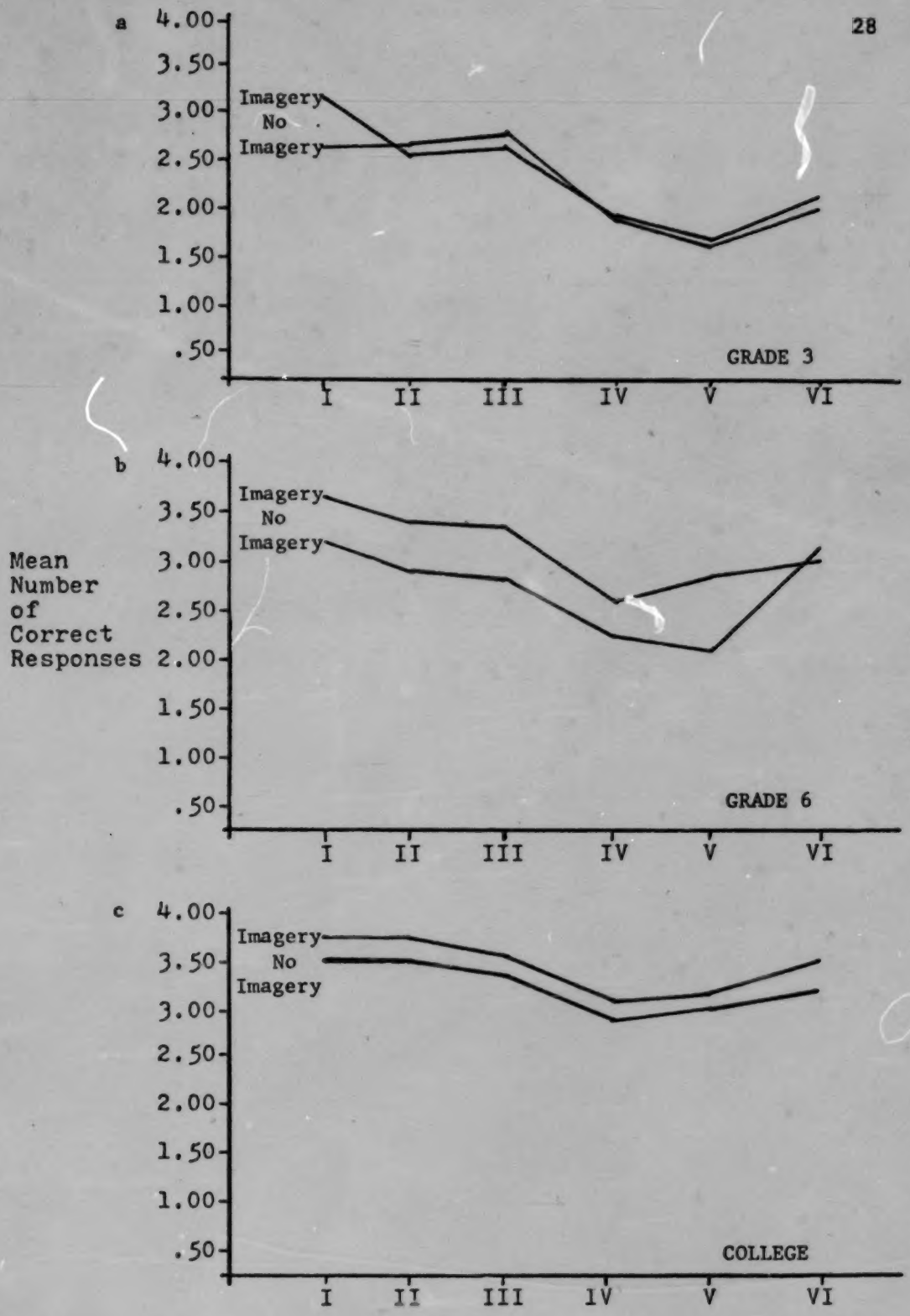


Figure 3

Mean Number of Correct Responses for each Item Type under Imagery and No Imagery Instructions for Third Grade, Sixth Grade, and College

would be more inhibitory for Item Type IV recall, because of the semantic switch. (The absence of a statistically significant interaction, however, probably makes the above statement insignificant.)

The Instruction by Trials interaction may be seen graphically in Figure 4. While a clear two-item difference in recall emerged between imagery and regular instructions on Trial I, this difference was reduced to about a half of one item on the second trial. Most of the variance due to instructions, then, is accounted for on the first trial. By the second trial the sixth graders not instructed to use imagery have been able to "catch up" to their imagery-instructed counterparts due to practice effects.

In contrast, the Item Types by Trials interaction was not significant ($F = 2.19$ with 5 and 54 df). This result points out the consistency of the item type profiles across trials. Even though the instructional effects were somewhat erased on the second trial it is interesting that the item type effects were still able to hold up.

Finally, no significant effects due to Instruction by Item Type by Trials interaction were found ($F = 1.73$ with 5 and 54 df). This finding indicates that the relatively consistent effect of instructions for each item type was the same for both trials.

College

The between-subjects comparison of instructions did not reveal any significant effects for the college sample ($F = 2.00$ with 1 and 58 df). However, a look at Table 4 indicates that almost a full item difference in recall existed in favor of the imagery-instructed group.

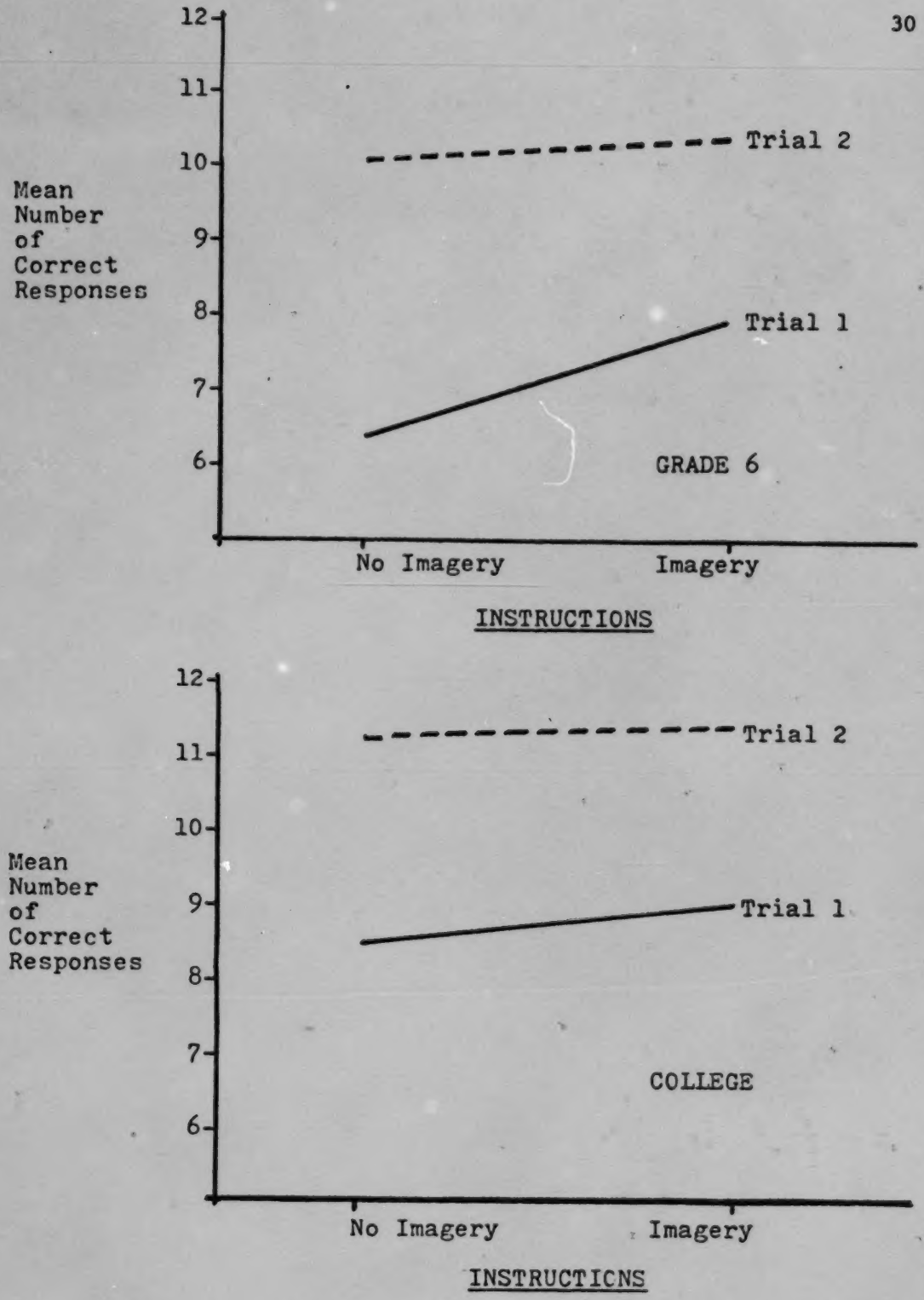


Figure 4

Mean Number of Correct Responses under each Set of Instructions for each Trial: Sixth Grade and College

Table 4

Mean Number of Correct Responses for Each Item Type and each Trial: College

Trial 1:

	Item Type I	II	III	IV	V	VI	
No Imagery	1.67	1.60	1.50	1.13	1.20	1.37	8.47
Imagery	1.73	1.73	1.60	1.33	1.30	1.63	9.32

Trial 2:

	Item Type I	II	III	IV	V	VI	
No Imagery	1.90	2.00	1.93	1.83	1.83	1.93	11.42
Imagery	1.97	2.00	1.97	1.77	1.87	1.93	11.51

Both Trials:

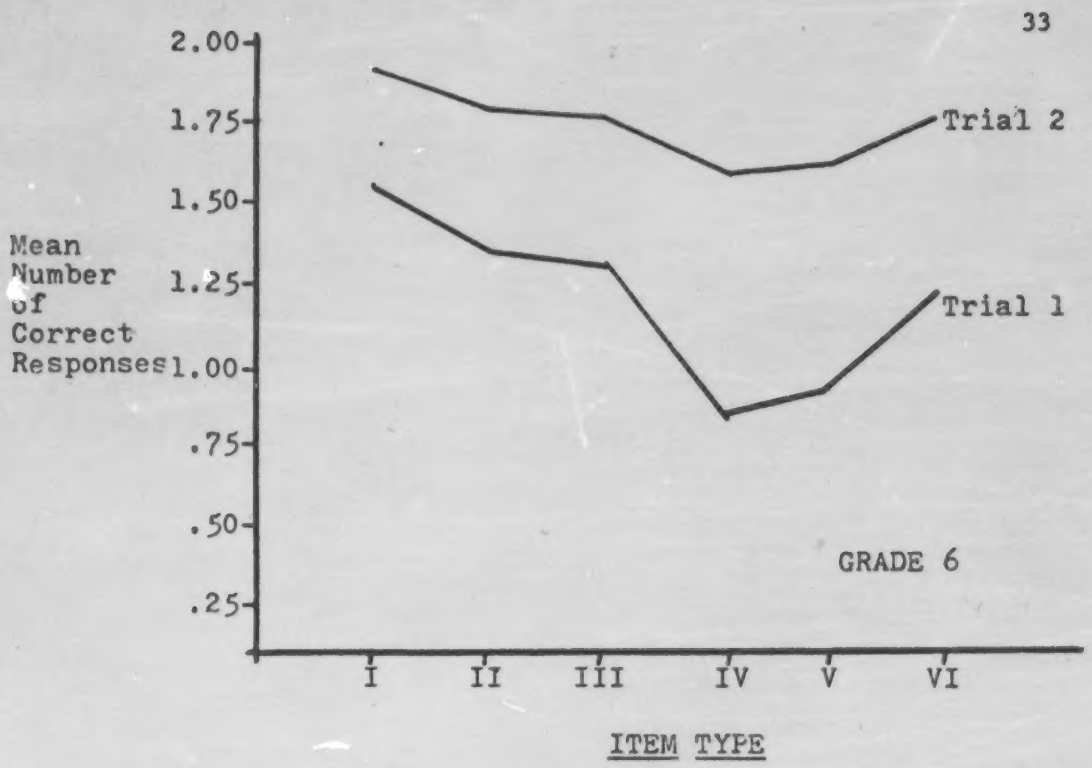
	Item Type I	II	III	IV	V	VI	
No Imagery	3.57	3.60	3.43	2.97	3.03	3.30	19.90
Imagery	3.70	3.73	3.57	3.10	3.17	3.57	20.84

At the same time, the Instructions by Trials interaction was significant (F = 3.19 with 5 and 49 df), and, as can be seen, most of the instructional difference was accounted for on the first trial (see Figure 4). By the second trial, the regular-instructed group had "caught up." A combination of ceiling (only 12 items) and practice effects is the probable explanation.

As was true for the third and sixth grade data, Item Types again produced a significant effect (F = 7.29 with 5 and 54 df). As may be seen in Figure 2, the item type profile is parallel to those of the two other age groups. Item Type II is slightly above Item Type I, with a small drop in recall for Item Type III. As expected, the sharpest decrease in recall was observed between Item Types III and IV. A very slight increase in recall is apparent between Item Types IV and V, and just as in the third and sixth grade samples, Item Type VI falls between III and IV.

In order to determine the specific item type differences that may have accounted for the item type main effect, post hoc comparisons were made. Pair-wise comparisons revealed that Item Type I was significantly different from Item Types IV and V, and Item Type II also was significantly different from those two item types. As happened for the third and sixth grade groups, a significant negative linear trend emerged for Item Types I-IV. Again no quadratic and cubic components were evident.

As noted previously, a finding that occurred only for the college sample was a significant Item Types by Trials interaction (F = 3.39 with 5 and 54 df). Looking at Figure 5, it may be seen that much sharper



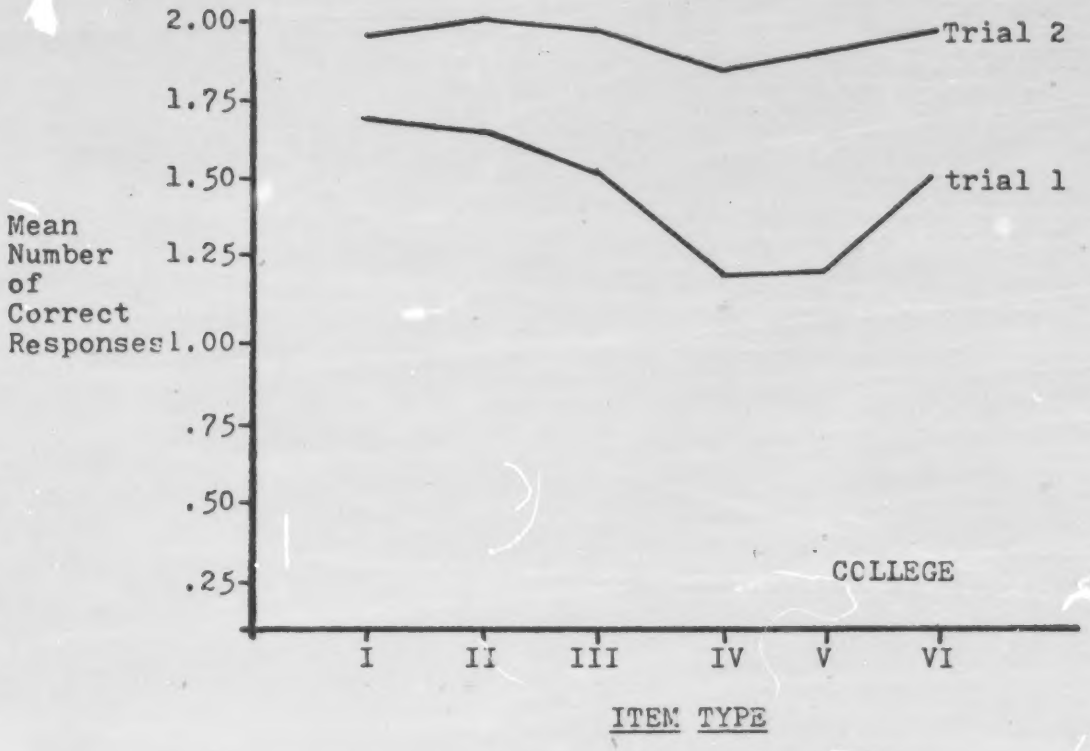


Figure 5

Mean Number of Correct Responses for each Item Type on each Trial: Sixth Grade and College

differences occurred between item types on the first trial. The profile for Trial I is more similar to the sixth grade data than is that of the combined college trials. The ordinal ranking of item types on the first college trial is the same as the sixth grade profile. On that first trial recall on Item Type II is slightly lower than on Item Type I, but on the second trial all item types are more closely bunched together as a result of ceiling and practice effects, and Item Type II passes Item Type I in ordinal position. College students, by the second trial, have evidently learned the "switch" game (i.e., the change in meaning between study and test trial verbs, with respect to Item Type IV) and the resulting item type differences are mostly erased.

The Instructions by Item Types interaction was not significant (F = 1 with 5 and 54 df). Thus, the item type differences are assumed to be similar for both types of instructions. This finding is counter to the prediction that imagery instructions would facilitate certain item types, and be interfering for especially Item Type IV. Figure 3c reveals remarkably consistent differences between instructions for each item type.

Much as expected, the trials main effect was significant (F = 177.53 with 1 and 58 df). Improvement in recall was substantial from Trial I to Trial II, about two and a half items. This improvement is related to the significant interactions of Trials with both Item Types and Instructions which have been reported above.

Finally, the Instructions by Item Types by Trials interaction did not attain significance ($F < 1$ with 5 and 54 df).

Chapter V

DISCUSSION

The results of this study reveal some interesting findings. Fortunately, many of them fit into the pattern predicted before the experiment was undertaken. Despite the fact that most studies in the field of behavioral science produce certain results that are not easily interpreted and that raise questions to be resolved later, it is again fortunate that this study has revealed remarkably little that cannot be explained.

Instructional Sets

Most important are the findings relative to the instructional sets, i.e., imagery vs. non-imagery. It was predicted that the greatest difference between imagery-instructed and regular-instructed groups would occur at the third grade level, with decreasing differences occurring at the sixth grade and college levels. Imagery instructions did seem to be effective at the latter two levels, although only the sixth grade difference was significant statistically. However, the third grade data revealed no significant difference. That is, imagery instructions did not facilitate learning at all for third graders, contrary to the prediction.

Very little doubt exists that imagery is an effective mediator for college-adult Ss (Bower, 1969; Paivio & Yuille, 1969; Wallace, Turner, & Perkins, 1957). However, one of the purposes of this study was to examine the comparative effects of imagery instructional sets for different age groups. No research to date had yet answered the question of how low in age imagery can be used to facilitate learning. Taylor & Black (1969) and Taylor, Joseberger, & Prentice (1970) demonstrated such facilitation with sixth graders, and Spiker (1960) found imagery to be useful in learning for fifth graders. To date, these had been the only known attempts to use this kind of imagery with elementary school children. Thus, the failure of the present study to demonstrate its usage with third graders may suggest a basal age at which such instructions become useful (i.e., somewhere between third and fifth grade).

While it was predicted in this study that instructions to use imagery would enhance performance for third graders even more than it would for the other two age groups, two alternative hypotheses were proposed to account for the non-occurrence of such a result: a) third graders are no different than older subjects in their use of self-initiated imagery, or b) third graders may simply be too young to effectively use imagery instructions. More support is given for the second of these hypotheses for several reasons. For one, while the use of self-initiated imagery by subjects not instructed to use it would lessen the differential in performance between the two groups, a difference does nonetheless occur at both the college and sixth grade levels, albeit probably only on the first trial for the college data. And, in

accordance with the prediction, the instructional difference is greater for sixth graders than for collegiates (adults), probably because more college subjects use self-initiated imagery strategies. If some third graders were using such strategies on their own, we would still expect at least a small difference to appear, as we see with the older subjects. A closer inspection of the third grade data, however, reveals no such similarities. Figure 3a shows the imagery and non-imagery curves to be virtually on top of one another, and Figure 1 also provides a picture of their closeness.

Furthermore, it could probably be suggested that imagery instructions did more to confuse third graders than to enhance their performance. It must be considered that the time available for the child to process the sentence and convert it into an image was very short (5 seconds). This time limit would be equally as important on the test trial where the child must convert the mental image (picture) of the response word back into an English word and report it to E within the 5-second limit. Paivio (1970) reports that younger children have greater difficulty than adults in making the symbolic transformation from mediating image to the required verbal response (i.e., supplying the verbal label to the picture) and Davidson (1970) offers support to a similar hypothesis espoused by Rohwer (1970) which posits that imagery becomes relatively more effective with increasing age because older children are more active or capable of storing verbal tag information with an imposed image.

Thus, it might be that the child has the image stored, but he can-

not convert it into a verbal response easily, or in the time available. It must be considered, however, that the above hypotheses are based upon a different instructional format than that employed in the present study. Davidson and Adams (1970) induced imagery by having S see a juxtapositional scene involving an already provided picture, while a prepositional phrase was uttered aloud. This type of "imposed imagery" is not necessarily synonymous with the subject-constructed imaginal scenes of the present study, and the generalizability from one to the other is questionable. Also, in the present study the S could take advantage of the sentence stem provided on the test trial, and it must be argued that these stems function more as cues or triggers for the verbalization of the correct response than do the single pictures provided in the other studies cited (Rohwer, 1967). But, the fact that imagery-instructed Ss could recall no better than regular-instructed Ss, even with such verbal cues lends more support to the notion that third graders could not use the imagery instructions.

The evidence seems to point toward a stronger ability on the part of young children to use verbal elaboration rather than imaginal elaboration. Just as it has been found that kindergarten children can usually generate conjunctive phrases, but not sentences, linking two nouns (Rohwer, 1967), it has also been demonstrated that third graders can generate their own sentential elaboration, but, on the basis of this study, cannot effectively deal with imaginal elaboration. Indeed, Reese (1970) has asserted that "there is a developmental trend in that imagery becomes more effective with increasing age". To be sure, an

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examination of the imagery studies conducted so far reveals a cross-section of different experimental approaches and artifacts that preclude highly generalizable interpretations. On the other hand, the absence of learning facilitation via imagery that has been demonstrated with young children in such a cross-section of experimental situations also lends power to the theory that it is not a preferred mode for young children. A comprehensive study employing both "imposed imagery" (Davidson & Adams, 1970) and subject-constructed imagery (the type taught to Ss in the present study), and manipulating inter-item time intervals would shed some more light. First, such a study would answer some questions regarding the experimental artifact of time. It could be that providing more time would allow a third grader to more effectively make use of imagery instructions. Second, it would provide a direct comparison of the imposed pictorial imagery employed in previous studies with the self-constructed imagery employed in the present study. The data obtained could provide a broader base from which to talk about the kinds of imagery effective or not effective with young children than presently exists.

One thing that may be established from the present study is that imagery is an effective mediator for sixth grade children. Taylor & Black (1969) had demonstrated it previously, and it was replicated here. Spiker (1960), of course, provides evidence that such strategies are useful for youngsters as low as fifth grade.

Although the three age groups were not compared statistically, it does appear that the imagery instructions were more useful for sixth

graders than for college students. It was hypothesized that such a result would occur because previous research (Paivio, 1969) indicated that more college students would use such strategies independently of being so instructed. It is likely, though, that the manifestation of a significant instructional effect at the college level was prevented by a ceiling effect, because both subsets of college students were attaining nearly 100% correct recall on the second trial. Even so, no ceiling effect occurred on the first trial (see Table 4) where a full item difference in favor of the imagery-instructed college Ss was obtained. At the same time, a two-item difference was obtained for sixth graders on the first trial (see Table 3), and despite the lack of a direct statistical test, this finding does boost the notion that imagery instructions are helpful for college Ss but even more beneficial for sixth graders. The conclusion, then, is this: imagery is an effective mediator for both age groups with sixth graders more likely to benefit from the training procedures, and college students more prone to already have such learning strategies stored away in their learning repertoires.

That most of the activity due to instructions was taking place on the first trial is attested to by the significant Instruction by Trials interactions for both age groups (sixth grade and college). By the second trial Ss given standard instructions were learning the task almost as well as those instructed to use imagery. Figure 4 provides a clear picture of what is happening. It may be observed that first-trial learning differences (due to instruction) are more acute for the sixth graders than they are for the college Ss. On the second trial

there is virtually no instructional difference in the college sample, while a slight, but much smaller difference than that obtained on the first trial, exists for the sixth graders. Simple developmental differences between the two age groups probably account for the fact that college students "ceilinged out" while the sixth grade data still revealed a small instructional effect.

Effects due to Item Types

The item type profiles obtained for the three age groups present some astounding similarities. Figure II reveals graphically the three profiles, and one is immediately struck by the virtual parallelism of the three curves. The significant decreasing linear trends between Item Types I-IV for all three age groups (with the absence of any statistically significant quadratic or cubic components contributing to curvilinearity) exemplify one portion of that parallelism. That portion of the profile can be thought of as a decreasing straight line.

For each grade level the post hoc pairwise comparisons reveal Item Type I to be significantly different from Item Type IV, yet Item Types I, II, and III are not statistically different from one another. This patttern implies that mild semantic changes, the kinds of changes manifested via the verb manipulations on the first three item types, have little or no effect on subsequent recall; complete semantic changes, on the other hand, the kind resulting from the verb manipulation on Item Type IV, may interfere with recall. Indeed, some recent studies (e.g., Begg & Paivio, 1969) have suggested that concrete sentences render semantic changes more recognizable than lexical changes. In the

present study the changes that take place in Item Types I, II, and III might be considered lexical, and they may have gone virtually unnoticed because the meaning changes were slight. However, Item Type IV contains a most definite semantic change which quite clearly had a detrimental effect on recall.

Another outcome that is consistent across the three age levels is the relatively consistent poor performance measured on Item Type V. In terms of pairwise comparisons it is significantly worse than both Item Types I and II, much as is Item Type IV (only for sixth graders is II not significantly different from IV). Although this outcome was initially surprising in another study (Levin and Horvitz, in press) its now consistent appearance makes one believe its validity. The most plausible explanation for the occurrence is that the verb-to-conjunction change that takes place between study and test trials serves to imitate the same type of semantic change that characterizes Item Type IV--thus the similarity between performance on the two item types. It seems reasonable to hypothesize that a complete change in sentence meaning (Item Type IV) is somewhat equivalent to a change from a meaningful sentence to a conjunctive phrase (Item Type V) where the test context loses its meaning. That the proximity of Item Types IV and V supports the idea that they contain similar semantic content has yet to be demonstrated empirically. This matter will be returned to in ensuing paragraphs.

Although Item Type VI is not statistically different from Item Type V for any age group here it is nevertheless consistently higher.

This result raises the question of why the conjunction-conjunction condition, which, as many research studies have shown (Rohwer, 1967), contains mediational content inferior to that of complete sentences, should facilitate learning relative to Item Type V, a condition that does utilize a sentence on the study trial. A recent study by Levin, Horvitz, and Kaplan (in press) attempts to explain some of this. Noun pairs were embedded either in sentences or conjunctive phrases. In one condition the nouns alone were presented to S visually, while the sentence or conjunctive context was heard aurally; in another condition the whole sentence or conjunctive context was seen and heard by S. It was found that sentential facilitation occurred only in the former condition. Analysis of response errors indicated that the visual presentation of complete sentence materials may orient the S to aspects of the sentence other than the required response noun, and thus provide for response intrusions; visual presentation of the nouns alone, however, would direct S to the noun associates themselves, yet still allow him to derive the benefit of the semantic content aurally.

The use of printed verbal materials together with simultaneous aural presentation in the present study may then represent one reason for the inferior performance on Item Type V relative to Item Type VI. However, the printed material phenomenon does not explain why recall on Item Type V is consistently worse (though not statistically) than that on Item Type VI. To account for this strange occurrence we can perhaps isolate two processes that might be involved in causing the reversal of what previous research would have one expect in reference to Item

Types V and VI. First, there is the aforementioned possibility that the verb-to-conjunction transition in Item Type V represents a semantic change that is as detrimental to recall as is the change occurring in Item Type IV. This factor would render relatively low performance on Item Type V. Second, previous research which has found sentence facilitation with printed materials has consisted of presenting the stimulus noun by itself (on test trials) and not with a conjunction. If the interference notion introduced above is true, then the notion that a study-test change from verb to conjunction is equivalent to a study-test change from verb to a noun alone is seriously in question.

A direct comparison might be made via an experiment employing the following kinds of conditions:

1) Nouns embedded in sentences employing the same kinds of study-test semantic changes as Item Type IV
2) Nouns embedded in contexts employing the same study-test changes as Item Type V (verb-to-conjunction)
3) Nouns embedded in a sentence on study trial, with the noun stimulus alone presented at test
4) Nouns embedded in conjunctive phrases on study and test trials, as in Item Type VI
5) Nouns in a conjunctive phrase on study trial, with the stimulus noun presented alone at test

A direct comparison between Conditions 4 and 5 would get at the question of how equivalent Item Type VI is to previous research done

with conjunctive context on nouns (i.e., conjunctive phrase on study, noun only at test). If Condition 4 were found to be significantly higher than Condition 5, then part of the reason for the Item Type VI potency in the present study, and in the Levin and Horvitz study might be accounted for, though at this time not adequately understood.

More enlightenment would be added, however, by a contrast between Conditions 2 and 3. Such a comparison would, in fact, provide some first-hand evidence of whether Item Type V is introducing a semantic effect interfering with recall as Item Type IV does. If the verb-conjunction condition were significantly lower than the verb-noun condition it would lend good support to the interference hypothesis as an operative factor in Item Type V.

If a difference in favor of Condition 3 (verb-noun) emerged over Condition 5 (conjunction-noun), as would be expected from previous research--or if they were equal, considering the recent "printed sentences effect" (Levin, Horvitz, and Kaplan, in press)--we would be at the heart of the matter. That result together with the verb-noun superiority over the verb-conjunction condition, would account for the present findings which have placed Item Type V so low in the facilitation scale.

Finally, it should be added that the "mixed list" format employed in the recent Levin and Horvitz study, and in the present study might be a factor, as most previous research in the area has been done with "independent groups". If none of the above-predicted effects were to

occur, the issue would be most mysterious, and also frustrating, considering the paucity of available explanations.

The item type profile obtained in the Levin and Horvitz study was not only replicated in the sixth grade sample, but for all three age levels. Although some subtle differences exist, notably within the first three item types, the overall shapes of the curves are extremely similar. The role of semantic factors in learning becomes the focal point of interest in as much as the imagery instructional sets did not interact with item types. That is, regardless of item type, imagery had a more or less constant effect or non-effect on learning; so item type differences can be accounted for by semantic and syntactic changes in the learning materials. It is important to recognize that the semantic effects are parallel for eight-year olds, twelve-year olds, and young adults in this study and there is no reason not to interpolate the results to include all ages in between. Developmentally, the importance of the findings could be paramount. If one can maintain from these results that students at each of these stages of development are faced with equal tasks in processing and retrieving semantically equivalent kinds of information then one might conclude that the specific kinds of cognitive operations involved are not different for different age levels. The demonstration of verbal elaboration as a facilitator in learning across age dimensions (Rohwer, 1967) was significant in its own right; the present demonstration of some consistent foils to this facilitation across age dimensions is equally noteworthy. More research of this sort across socioeconomic and cultural lines might

provide a rich source of information concerning language, learning, and environment--and in the long run, educational tools to be used with children.

The equality in performance among Item Types I, II, and III before the sudden drop on Item Type IV, mentioned earlier, further accentuates the importance of semantic factors in learning. It appears that the changes occurring between study and test on the first three item types are not acute enough to drop performance level significantly from Item Type I. Begg and Paivio's (1969) notion that lexical changes in concrete sentences pass unnoticed seems relevant here. Paivio (1970) even extends the notion as far as to say that exposure to these different lexical changes can enhance the S's experience, generalizing the facilitation offered by sentence contexts to new and subtly different sentence contexts. The semantic changes in Item Types I, II, and III are not noticeable enough in concrete sentences to bring about interference. Rather, it seems that the S's experience, i.e., his ability to see an interactive relationship between two concrete stimuli in similar but slightly different language contexts, comes to bear here. However, when the context meaning is altered more radically as in Item Type V, semantic change becomes a potent learning factor, in this case producing interference. According to Paivio, with the use of abstract nouns, on the other hand, lexical changes assume more potency and are more likely to produce obstacles to learning while semantic changes take on less relevance.

Interactions with Item Types

Further impetus to the above discussion is provided by an analysis of the Item Type by Trial interactions for the three grade levels. It will be noted that a significant interaction of these variables occurred only for college students. The fact that item type differences were consistent across both trials for the two younger age groups (and this finding also replicated the sixth grade data obtained in the Levin and Horvitz study) indicates the strength of the semantic effects inherent in these materials since 1) The use of a mixed list of 12 items limited the measure of performance on each item type to only 2 possible correct responses on each trial, and 2) The acquisition of test sophistication after the first trial could prepare the S to be aware of the changes taking place between study and test trials so that we might expect differences among item types to erase. Note that even the college profile for the second trial assumes the same shape as that of the first trial, albeit not as steep.

Figure 5 represents the Item Type curves trial by trial for the sixth graders and college students. It can be seen how the sixth grade Trial II curve still holds up fairly well while the college curve has smoothed out somewhat. Developmentally, we naturally expect the college students to reach ceiling before the sixth graders and to make quicker adjustments to the experiment-provided "tricks" (i.e., the study-test verb change, particularly Item Type IV), and precisely that should explain why the significant interaction occurred for the college students, but not for the sixth graders.

Let us now turn to the Item Type by Instructions Interactions, an expected finding that did not occur for any of the age groups. What this really does is provide even more emphasis on the importance of the semantic aspects of the learning materials. It should be remembered that one of the predictions of the present study was an interaction between Instructions and Item Types that would reveal stronger imagery effects for the semantically similar study-test item types and imagery-caused interference for the semantically dissimilar study-test item types. This prediction was based on the belief that imagery-instructed Ss would store an imaginal scene compatible with the contextual stem provided at test for Item Types I, II, V, and VI and incompatible with the stem provided for Item Types III and IV. A further 3-way "quasi"-interaction of Item Types, Instructions, and Age was also predicted (to be measured descriptively rather than statistically since each age group was analyzed separately) on the foundation that both the facilitative and inhibitive imagery effects would be lesser for the college students since many non-imagery instructed Ss would be expected to use such a strategy on their own.

Figure 3 reveals the effects of imagery instructions for each Item Type at the three grade levels, and we can clearly see that imagery instructions generally were facilitative for all item types (with the exceptions to be discussed later.) This occurrence does much to establish the independence of semantic factors as a formidable variable in learning whose respective effects are not affected by the imagery instructions. It also establishes the role of the imagery instructions as a procedure that can produce increments in recall regardless of the semantic "games" being played.

Figure 3a points out the relative ineffectiveness of imagery instructions with third graders. It seems that no consistent pattern was established, but rather that the instructional curves criss-cross haphazardly with performance being basically the same for both imagery and non-imagery Ss.

Figures 3b and 3c, however, reveal the activity taking place at the sixth grade and college levels, where the incremental effects of imagery instructions are quite visible. Of particular interest with the sixth grade data presented here is the parallelism between the imagery and no-imagery profiles, with the striking exception of Item Type VI, where amount of recall by the two groups is virtually identical. For the college sample, the incremental effects of imagery, although slight, are consistent across all Item Types and to approximately equal degrees.

An explanation seems to be in order for the sixth grade Item Type VI finding (despite the absence of a statistically significant Instructions by Item Types interaction). A pair of studies by Levin and Kaplan (in preparation) may have provided it. In those studies the instructional effects of imagery were noted on learning materials consisting either of objects or their noun referents (presented as pairs of printed words). It was found that the imagery instructions generally facilitated learning more when pictures rather than words comprised the stimulus material. It is possible, then, that the encoding process involved in imaginal mediation is--for sixth graders-- operative only with experimenter-provided cues that might direct the child in formulating the needed image. These cues take different forms for pictorial and verbal presentations: for the

former, the pictures themselves are sufficient materials from which to make the transition to an imaginal interactive scene, while for the latter semantic and syntactic mediators must be supplied. Both cases, however, represent extensions or elaborations of the printed noun pairs.

Another way of viewing this is that the conversion of a printed noun pair into an interactive imaginal scene probably requires two transformations: first, a translation of words into their object referents (or a picture of them); and then the generation of an interaction involving the two objects. In the case of paired pictures or printed sentences, however, only one tranformation is involved. That is, for pictured PA's, the child already has the pictures and need only supply the interaction; for sentence-embedded PA's, he already has the interaction and need only supply the pictures.

It seems, then, that although concrete nouns are known to be high in image-evoking capacity, the research to date has suggested that, given printed noun pairs, children have trouble making both of the above hypothesized transformations on their own, although given one they can generate the other. This contention is reinforced by the results of the present study where learning is facilitated on Item Types I-V, which all contain concrete sentences on the study trial, but not on Item Type VI, the only item type employing a conjunctive phrase. A limitation to this hypothesis, however, is that, as mentioned earlier, it is not known that the presentation of conjunctive phrases is equivalent to noun presentation alone (on the test rials).

One might further hypothesize a developmental trend with respect to the above. Third graders, it was found, could not utilize imagery

instructions even with the concurrent provision of sentences or pictures of objects. Sixth graders used such instructions effectively save for cases where only a conjunctive context was presented. College students seem to be able to utilize the instructions even with the conjunctive phrases, as evidenced by the consistent gains in recall pictured in Figure 3c (It will be recalled that the non-significant difference--across trials--of instructions was attributed to the ability of non-instructed college students to use such strategies on their own.) These developmental differences can have implications for further research and for educational purposes in terms of the specific conditions and materials appropriate for effective imaginal encoding.

More needs to be said about the boost that imagery seems to provide in learning irrespective of semantic context. Particularly with reference to Item Type IV where semantic change presented recall obstacles, imagery instructions still appeared to be facilitative. One might conclude that the visual encoding of the noun stimulus is most important, and certainly Paivio (1969 has suggested this. For, if imagery instructions facilitate response retrieval on Item Type IV where the response to be retrieved is topographically and semantically different from the one stored, the storage of the stimulus and its surrounding content must be considered as the key to retrieval.

Another potentially rich source of information could be obtained by recording response latencies, as a function of item types and instructions. The time it takes children to retrieve an Item Type IV response noun, for instance, compared to the time it takes response retrieval to

occur on other item types would get at the question of interference. Comparisons of latency time for any number of pairs of item types, or the same item type under each set of instructions might be made. This type of investigation seems to be a logical follow-up to the types of questions raised in this study, (e.g., the number of transformations an S is making).

For those who are able to do it it cannot be denied that imagery and instructions to use imagery can function as facilitating elements in the learning process. The role of imagery as a mediator has now been demonstrated many times and in this study it has proven its worth even against the formidable opposition provided by semantics. It is indeed hard to believe that such a potentially useful construct has been held in low regard in the field of psychology since the birth of behaviorism more than half a century ago. Its current revival and interest as a very real process in storing information in our "black boxes" and interacting with other processes in learning could be a breakthrough for education. For instance, discoveries regarding its current utility with different age groups have vast implications. Furthermore, the extension of paired-associate imagery research to prose learning, which is more representative of what children are taught, can bring us closer to the utility of imagery in teaching. Another potential gold mine might be happened upon by inspection of individual idfferences with respect to imagery. For instance, how is imagery ability related to creativity? Or, is it more useful with children of higher verbal ability? Questions similar to these are currently being asked by Professors Levin, Davidson, Wolff, and their associates at the Wisconsin Research and Development

Center for Cognitive Learning, in order to instate imagery as a viable and relevant tool in classroom learning.

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Chapter VI

SUMMARY

A recent revival in research dealing with the role of visual imagery in paired-associate learning has produced many studies indicating its usefulness as a mediator in facilitating recall of associated noun pairs. Paivio has isolated noun concreteness as the most important element necessary for evoking imagery, and has demonstrated the effective usage of imagery with college-age Ss. Only a few studies have investigated the facility of imagery with children (Taylor & Black, 1969; Spiker, 1960) but none of these dealt with children below the fifth grade.

Other studies have investigated the role of semantic factors in learning via the use of sentence-embedded noun pairs. In particular, Levin and Horvitz (in press) found that by manipulating the context of the embedded noun pairs to increasingly dissimilar semantic elements between study and test trials, a corresponding decrement on recall was demonstrated. Although this study was interpreted in terms of semantic differences, it is felt that the use of imagery mediators might have produced similar results.

The present study was an attempt to investigate concurrently the usefulness of imagery mediation instructions with paired-associate nouns in semantically dissimilar contexts, and the differential facilitation of such instructions at three different age levels (third grade,

sixth grade, and college). This represented a first attempt at using such instructions with children below fifth grade, and it also included a replication of the Levin and Horvitz study. It was first predicted that imagery instructions would show a decreasing effect as a function of age, i.e., it would be most useful for third graders, and least useful for college students since the latter would presumably be using such strategies independently. It was also predicted that imagery would facilitate recall on semantically similar study-test item types, and inhibit recall on semantically dissimilar study-test item types.

Subjects were 60 third graders and 60 sixth graders from a semi-rural school district in the Midwest, and 60 volunteer college students attending the University of Wisconsin at Madison. Half of the Ss from each grade were randomly assigned to a group either receiving imagery instructions or receiving standard PA instructions.

Each S received a 12-item "mixed list" of noun pairs embedded in six different item-type contexts. Item Types I-IV constituted progressively dissimilar contexts between the sentences studied and the frames supplied as test cues, where at one extreme the study and test trial contexts were identical, and at the other end dissimilar meanings were conveyed. In addition two control item types were included. Item Type V contained a sentence on study trial and a conjunction frame at test. Item Type VI employed conjunction phrases for both study and test trials.

Verbal materials were concurrently seen on a screen and heard on a tape recorder. Imagery Ss were instructed to formulate a mental image of the action taking place in each sentence, and told that this would aid him in later recall. Non-imagery Ss were told only to remember the paired nouns in each sentence.

Imagery instructions were found to facilitate recall significantly for sixth graders. However, no instructional effect was observed with third graders, and a small, but not statistically significant, effect occurred at the college level. Item type profiles for all three grades replicated the Levin and Horvitz study but the predicted interaction of instructions with item types did not occur. Thus, imagery instructions were generally beneficial for all semantic contexts at the sixth grade and college levels (but not significantly at the latter). Post-hoc analyses revealed a decreasing linear trend between Item Types I-IV for each grade level.

The interpretations placed on the data were as follows: 1) Imagery is a useful mediator for sixth grade children and college adults, and the non-significant instructional effect at the college level was due to a "ceiling effect"; at the same time, third graders are too developmentally immature to effectively utilize imagery instructions, 2) the importance of semantic factors in learning was further demonstrated by the replication of the Levin and Horvitz study, 3) imagery instructions, when they are effectively used, facilitate learning regardless of the semantic context involved. However, a developmental trend was evident with respect to the kinds and amount of experiment provided cues necessary for imaginal production and mediation.

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FOOTNOTES

[1]Some unpublished data indicate that if Ss are not told of the impending change they are distracted when the change occurrs on the test trial.

[2]It should be noted that for two noun pairs the test contexts for Item Types I-IV were probably constraining. These were "The HUNTER chops the _____" and "The POLICEMAN picks up a _____". This potential factor went unnoticed until after the study was completed. However, its possible effect would be to render Item Type V recall lower than Item Type IV since the test trial on V only contains the conjunction phrase and IV contains the sentence context.

APPENDIX

Noun pairs within each Item Type

Study	Test
I. The DOCTOR hammers a PIPE.	The DOCTOR hammers a ____.
II. The DOCTOR pounds a PIPE.	The DOCTOR hammers a ____.
III. The DOCTOR tightens a PIPE.	The DOCTOR hammers a ____.
IV. The DOCTOR smokes a PIPE.	The DOCTOR hammers a ____.
V. The DOCTOR hammers a PIPE.	The DOCTOR or a ____.
VI. The DOCTOR or a PIPE.	The DOCTOR or a ____.
I. A FRIEND arranges a DATE.	A FRIEND arragnes a ____.
II. A FREIND sets up a DATE.	A FRIEND arranges a ____.
III. A FRIEND cancels a DATE.	A FRIEND arranges a ____.
IV. A FRIEND eats a DATE.	A FRIEND arranges a ____.
V. A FRIEND arranges a DATE.	A FRIEND and a ____.
VI. A FRIEND and a DATE.	A FRIEND and a ____.
I. The MOTHER paces the DECK.	The MOTHER paces the ____.
II. The MOTHER walks the DECK.	The MOTHER paces the ____.
III. The MOTHER scrubs the DECK.	The MOTHER paces the ____.
IV. The MOTHER shuffles the DECK.	The MOTHER paces the ____.
V. The MOTHER paces the DECK.	The MOTHER or the ____.
VI. The MOTHER or the DECK.	The MOTHER or the ____.
I. A DOG sniffs the TRACKS.	A DOG sniffs the ____.
II. A DOG smells the TRACKS.	A DOG sniffs the ____.
III. A DOG digs the TRACKS.	A DOG sniffs the ____.
IV. A DOG crosses the TRACKS.	A DOG sniffs the ____.
V. A DOG sniffs the TRACKS.	A DOG or the ____.
VI. A DOG or the TRACKS.	A DOG or the ____.
I. The WAITER brings the GLASSES.	The WAITER brings the _____.
II. The WAITER carries the GLASSES.	The WAITER brings the _____.
III. The WAITER fills up the GLASSES.	The WAITER brings the _____.
IV. The WAITER wears the GLASSES.	The WAITER brings the _____.
V. The WAITER brings the GLASSES.	The WAITER and the _____.
VI. The WAITER and the GLASSES.	The WAITER and the _____.

	Study	Test
I.	The ACTOR speaks the LINE.	The ACTOR speaks the ____.
II.	The ACTOR says the LINE.	The ACTOR speaks the ____.
III.	The ACTOR remembers the LINE.	The ACTOR speaks the ____.
IV.	The ACTOR pulls the LINE.	The ACTOR speaks the ____.
V.	The ACTOR speaks the LINE.	The ACTOR and the ____.
VI.	The ACTOR and the LINE.	The ACTOR and the ____.
I.	A MAID sews a BUTTON.	A MAID sews a _____.
II.	A MAID mends a BUTTON.	A MAID sews a _____.
III.	A MAID drops a BUTTON.	A MAID sews a _____.
IV.	A MAID presses a BUTTON.	A MAID sews a _____.
V.	A MAID sews a BUTTON.	A MAID or a _____.
VI.	A MAID or a BUTTON.	A MAID or a _____.
I.	A CLERK breaks the RULER.	A CLERK breaks the _____.
II.	A CLERK smashes the RULER.	A CLERK breaks the _____.
III.	A CLERK uses the RULER.	A CLERK breaks the _____.
IV.	A CLERK crowns the RULER.	A CLERK breaks the _____.
V.	A CLERK breaks the RULER.	A CLERK and the _____.
VI.	A CLERK and the RULER.	A CLERK and the _____.
I.	A TEACHER ties a BOW.	A TEACHER ties a ___.
II.	A TEACHER knots a BOW.	A TEACHER ties a ___.
III.	A TEACHER undoes a BOW.	A TEACHER ties a ___.
IV.	A TEACHER shoots a BOW.	A TEACHER ties a ___.
V.	A TEACHER ties a BOW.	A TEACHER and a ___.
VI.	A TEACHER and a BOW.	A TEACHER and a ___.
I.	The GIRL grabs a BALL.	The GIRL grabs a ____.
II.	The GIRL takes a BALL.	The GIRL grabs a ____.
III.	The GIRL kicks a BALL.	The GIRL grabs a ____.
IV.	The GIRL dances at a BALL.	The GIRL grabs a ____.
V.	The GIRL grabs a BALL.	The GIRL and a ____.
VI.	The GIRL and a BALL.	The GIRL and a ____.

	Study	Test
I.	A HUNTER chops the WOOD.	A HUNTER chops the ____.
II.	A HUNTER cuts the WOOD.	A HUNTER chops the ____.
III.	A HUNTER piles the WOOD.	A HUNTER chops the ____.
IV.	A HUNTER enters the WOOD.	A HUNTER chops the ____.
V.	A HUNTER chops the WOOD.	A HUNTER or the ____.
VI.	A HUNTER or the WOOD.	A HUNTER or the ____.

I.	The POLICEMAN picks up a CLUB.	The POLICEMAN picks up a ____.
II.	The POLICEMAN lifts a CLUB.	The POLICEMAN picks up a ____.
III.	The POLICEMAN swings a CLUB.	The POLICEMAN picks up a ____.
IV.	The POLICEMAN joins a CLUB.	The POLICEMAN picks up a ____.
V.	The POLICEMAN picks up a CLUB.	The POLICEMAN or a ____.
VI.	The POLICEMAN or a CLUB.	The POLICEMAN or a ____.

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